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Data carrier for storing files, apparatus for managing such a carrier and method for processing data, in such a carrier.

The present invention relates to a data carrier for storing files.

The invention also relates to an apparatus for managing the files stored in a data carrier comprising a light source for illumination, an optical data carrier, and a motor for driving said data carrier, as well as a method of processing data in such a carrier.

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The patent document WO 00/58958 discloses such an apparatus.

10 The invention finds its application notably in optical data carriers, known as SFFO (Small Form-Factor Optical), having the ability to be rewritable. These data carriers are used with apparatus supplied by batteries, so it is important that the battery life is as long as possible.

15 The SFFO carriers are driven at constant angular velocity. The measures that the invention proposes turn to account the properties of the constant angular velocity.

A data carrier in accordance with the invention comprises files, the transfer rates of which are dependent on their locations on the data carrier, the files often required by the user being in a location that provides a high file transfer rate.

20 The basic idea of the invention is that the supply power is consumed when the carrier is driven and the light source is on. For example if the user often wants to play a MP3 file having 4.5 MB, it takes 1s for being transferred into a process unit for being listened to by the user if the file is on the outer part and 2s if the file is on the inner part of the disc. Supply power is thus economized in that the motor and the source light are used less.

The invention relates to a method of economizing the supply energy of an apparatus managing a data carrier having power-consuming elements which consume supply energy during a transfer of data from the data carrier, which method comprises the steps of:

- 5            - determining the more frequently used files,  
              - allocating the more frequently used files to locations on the carrier which are faster for transferring,  
              - supplying said power-consuming elements when the transfer has been completed.

10          These and other aspects of the invention are apparent from and will be elucidated, by way of non-limitative example, with reference to the embodiment(s) described hereinafter.

In the drawings:

- 15          Fig.1 shows an apparatus in accordance with the invention,  
              Fig.2 shows a data carrier in accordance with the invention  
              Fig.3 shows a block scheme of a processor set for an apparatus in accordance with the invention.  
              Fig.4 shows a scheme for the managing of files in a data carrier in accordance with the invention.
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Fig.1 shows an apparatus in which a data carrier 1 having a disc shape is placed. This data carrier may be an optical disc. In Fig.1, the carrier is shown in cross-section. A disc motor 3 rotates the carrier. On this carrier 1, a lens 12 focuses a laser light beam 14. The laser is mounted in a sledge 16 that can be moved by a sledge motor 20 for exploring the whole disc as indicated by the arrow 22. Inside this sledge, a laser diode 25 is placed for illuminating the optical data carrier. The sledge also contains photo detectors, not shown, that provide signals. These signals are used, on the one hand, for providing useful information, for instance to a loudspeaker 32 via a user interface circuit 34 and, on the other hand, for controlling

various servos via a control interface 38. A splitter device 42 splits these signals for being correctly directed to the interface circuits 34 and 38. A processor set 50 controls the overall operation of the apparatus. A battery 52 supplies this apparatus. A charger device 54 can charge the battery when this is needed. Two switches 56 and 58 are used in supplying of the apparatus. When the switch 56 is on, the motors 20 and 3 are supplied and so is the laser diode 25. When it is off said elements 20, 3 and 25 are not supplied. The other elements of the apparatus remain supplied. A major part of the energy is consumed when the switch 56 is on.

When a file placed on the disc 1 is required, the disc 1 is driven at a constant speed or angular velocity (CAV). The data rate is thus higher at the outer radius of the disc than at the inner. For example, the bit rate is about 18 Mbps at the inner and 36 Mbps at the outer radius. Then reading of the same file from the inner radius instead of the outer radius requires one second longer. During this second the laser diode 25 is switched on and the disc 1 is spinning. The difference in supply power is significant. The switch 56 can be off after the transfer and an economy of energy is obtained when the transfer time is shorter.

The invention proposes to allocate the most frequently used files close to the outer radius, so that the battery life can be significantly increased.

Fig.2 shows, highly schematically, the locations of various files on the optical disc 1. The files F1 and F2 are files frequently used and file F10 is less used.

Analyzing the use of the files renders it possible to determine how often they are read. The processor set 50 as shown in the Fig.3 comprises a processor 60 with a counter 62, which can be realized by software means, and a table 64. Thus it is possible to store the repetitions of file usage. In this table 64, the names of used files F1, F5,...Fn are stored in comparison with the number of times each file is used k1, k5,.. kn. Another way is to take into account the order of the files as defined by the playlists (taking into account the most frequently used playlists)

The counters may be reset after the files on the disc have been re-allocated for placing the more frequently used file in the outer most locations of the disc. This may distort the system because a file may have been used a lot during a

short period and this usage need not reflect the longer-term file usage. Alternatively, the date the file was last used may be stored along with the counter to record whether the file was recently used. When performing the re-allocation, other factors need to be taken into account as well as the frequency of file usage. For example, the size of  
5 the files must be considered.

The reallocation will typically be done when the disc is in an apparatus connected to a power supply, e.g. when it is recharging its batteries or when the disc is placed in a fixed device such as a PC. The system may want to record when re-allocation was last performed so that the files are not reallocated too often (this may  
10 result in degradation of the disc as the same fast locations are overwritten too often).

Another embodiment of the invention proposes to use the UDF File system well known in the state of the art.

There are two ways to implement this feature in the UDF File System. In both cases an UDF implementation that is not aware of this feature will still be able  
15 to read the files without problem.

UDF allows applications to define an extension to the File Entry table for their own use. This is called "Application Use Extended Attribute" (see Fig.4). The table INF shown in Fig.4 provides for a given file FA a room EXFA for an extra information. The usage is not defined in the UDF specification; it is up to the  
20 application using the file system to decide how to use it. The way this will work in practice is that the application will read and set the values of this field and therefore control its use. This field is specified in the UDF file system, so an implementation that does not support this extension field will still be able to read a disc that does use it. This extra field may be used to implement file usage counting but it may lead to  
25 problems if an implementation already uses this field for another purpose. With this solution the counting must be done by the file system, the application will know nothing about this field

Controlling the file counting from the application has an advantage because the application knows whether the file was actually used by the user. For  
30 example, the user may have skipped an audio track after a few seconds. In this case

the application may choose not to count this as a file usage. Similarly, files may be accessed on disc and cached by the application but then not used by the user.

The re-allocation may also be performed under the application control. For example, when the disc is placed in a drive connected to a power supply (e.g. a PC), an application may analyse the file usage and then decide how to optimally re-allocate the file data. Then the application may choose to re-allocate the files so that the most frequently used files are recorded on the outside of the disc. One way to do this is for the application to treat the disc as a block device and bypass the normal file system implementation. The application will create a disc image with the files in the correct locations and then copy the complete disc image including File System tables to disc.

It is also possible to let the file system perform the reallocation, but then the file system implementation must implement the specific reallocation strategy.